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Maternal Near-Miss in a Tertiary Care Hospital: A Prospective Study From North India

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Abstract—Background: **Maternal near-miss is defined as a 'woman who nearly died but survived a complication during pregnancy, childbirth or within 42 days of termination of pregnancy'. A sudden and unexpected event during pregnancy, childbirth, or even after delivery, is a risk that is faced by every pregnant woman.**

Aim: **This study aimed to establish the incidence of maternal near-misses, and to evaluate the clinical and epidemiological profile and causes of maternal near-miss.**

Materials and Methods: **This was an observational prospective study, conducted in Lalla Ded Hospital for a period of 18 months after obtaining ethical clearance. Women who fulfilled any of the WHO criteria for MNM were included in the study as maternal near-miss cases.**

Results: **The hospital witnessed 36,273 live births over the period of the study, of which 821 involved a near-miss. This equates to a MNM incidence ratio of 22.63 per 1000 live births. The mortality index in our study was 3.97%, and the near-miss to mortality ratio was 24.14:1. Haemorrhage was the leading cause of MNM (N=429 or 2.25%), followed by hypertensive disorders of pregnancy (N=280 or 34.10%). Anaemia was the most common associated factor and was present in 460 (56.03%) patients.**

Conclusion: **Early identification of risk factors for placenta accreta spectrum, hypertensive disorders of pregnancy, medical disorders complicating pregnancy, anaemia, previous Caesarean section, and multifoetal pregnancy, among others, and thereby prompt management of such conditions, plays a critical role in the optimal management of MNM.**

Index Terms— **Maternal Near-Miss; Mortality; Pregnancy.**

I. INTRODUCTION

Maternal mortality remains a significant challenge in developing nations, and maternal near-miss (MNM), referring to cases in which a woman nearly dies but survives a severe complication during pregnancy, childbirth, or within 42 days postpartum/ post-termination, serves as a crucial indicator of the quality of maternal healthcare [1]. The primary causes of MNM include obstetric complications such as severe haemorrhage, hypertensive disorders such as pre-eclampsia and eclampsia, sepsis, obstructed labour, and pre-existing medical conditions such as heart disease, diabetes, and anaemia. Contributing factors also include healthcare system deficiencies such as delayed access to care and inadequate infrastructure [1]. The consequences of MNM are significant, ranging from immediate physical and psychological impacts on the mother to long-term health issues, social and economic burdens, and adverse neonatal outcomes. Prevention strategies focus on improving access to timely, skilled care, enhancing healthcare infrastructure, raising community awareness, and implementing evidence-based guidelines [2]. Global statistics reveal disparities in MNM rates

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between high- and low-income countries, underscoring the need for targeted interventions. Current research highlights the importance of ongoing studies to address knowledge gaps and guide future policies aimed at reducing MNM and improving maternal health outcomes [2].

In 2009, the World Health Organization (WHO) defined maternal near miss as 'a woman who nearly died but survived a complication during pregnancy, childbirth, or within 42 days of termination of pregnancy' [1]. The criteria for identifying MNM cases are categorised into clinical, laboratory, and management-based indicators that reflect the severity of complications during pregnancy, childbirth, or within 42 days postpartum. Clinically, MNM includes conditions such as severe pre-eclampsia with hypertension and organ dysfunction, eclampsia marked by convulsions, severe postpartum haemorrhage with blood loss exceeding 1,000 ml, uterine rupture, and severe systemic infections such as sepsis. Laboratory-based criteria include severe acute anaemia with haemoglobin levels below 7 g/dl, coagulation disorders such as disseminated intravascular coagulation (DIC), and acidosis with a pH below 7.1. Management-based criteria include the use of critical interventions such as blood transfusions, vasoactive drugs, hysterectomy, admission to an intensive care unit (ICU), prolonged hospitalisation due to severe complications, mechanical ventilation for more than 12 hours, and dialysis for renal failure. These criteria help healthcare providers to effectively identify and manage MNM cases, ultimately improving maternal health outcomes.

India continues to grapple with alarmingly high maternal mortality rates, witnessing approximately 120 maternal deaths per day [2]. A paper released by the WHO in 2015, titled 'Trends in Maternal Mortality: 1990 to 2015', draws estimates from various reputable sources such as the World Bank Group, United Nations Population Division, UNICEF, UNFPA, and WHO. According to this publication, Nigeria and India collectively accounted for more than a third of global maternal deaths in 2015, with Nigeria recording approximately 58,000 deaths (19%) and India with 45,000 deaths (15%) [3].

Despite a decline in maternal mortality ratio (MMR), from 301 per 100,000 live births in 2001 to 167 per 100,000 in 2014, India failed to meet the target set by Millennium Development Goal (MDG)5 (MMR < 150/100,000 live births) [4,5]. The Sustainable Development Goals, particularly Goal 3 (target 3.1), aim to further reduce MMR to below 70/100,000 live births by 2030 [6].

Maternal near miss (MNM) remains a vital public health issue in India, with significant maternal mortality and morbidity rates, particularly in rural and underserved areas. While the WHO's criteria for MNM help identify life-threatening complications that women survive, the topic's importance in India extends beyond these definitions. MNM highlights critical gaps in the healthcare system, such as delayed access to care, and reflects the challenges posed by poverty, gender inequality, and inadequate healthcare infrastructure. Addressing MNM in India is essential for improving maternal health outcomes, targeting interventions more effectively, and promoting broader socio-economic development by ensuring that every woman has access to the care she needs during pregnancy and childbirth. The majority of maternal deaths and disabilities are preventable, given the availability of established medical solutions. Sadly, 99% of maternal deaths occur in developing countries characterised by inadequate transport systems, limited access to skilled caregivers, and deficient emergency obstetric services [7].

II. METHODOLOGY

This was an observational prospective study, conducted over a period of 18 months from August 2017 to February 2019. The study was conducted in the Department of Obstetrics and Gynaecology at Lal Ded Hospital, Srinagar. Lalla

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Ded is a 700-bed tertiary care maternity hospital associated with Govt. Medical College, Srinagar, and is known to cater to hundreds of thousands of patients annually. After obtaining proper informed consent, data were collected from those patients who experienced MNM events during their hospital stay or upon admission, using a proforma survey questionnaire. Characteristics including the patient's age, parity, gestational age at the time of near-miss, type of admission, booking status, and interventions taken to save the life of the patient, were noted. Details of investigations undertaken for anaemia, septicaemia, organ system dysfunction/failure, etc., were collected from the patient's case records. The mode of delivery and foetal outcome were also noted. Women who fulfilled any of the WHO criteria for MNM were considered eligible for this study as maternal near-miss cases.

The selection criteria included women aged 15-49, who were currently pregnant, post-partum, or had been pregnant within the past 42 days, and who had experienced severe complications during any of the abovementioned stages. The study specifically targeted those who had survived severe complications such as haemorrhage, hypertensive disorders, sepsis, or other conditions that meet the World Health Organization's maternal near-miss (MNM) criteria, including those requiring intensive care or specialised interventions. Conversely, the exclusion criteria eliminated women who were not pregnant and had not been pregnant within the past 42 days, those without recent pregnancy-related complications, as well as cases that did not meet the MNM severity threshold. Also excluded were participants with incomplete records that failed to confirm their MNM status, as well as non-survivors, as the focus was solely on survivors.

Data Analysis

To correct any errors, the data were first entered into a Microsoft Excel spreadsheet and examined thoroughly. IBM Corporation's SPSS Statistics for Windows (Version 27.0, released in 2020, Armonk, NY, USA) was used for statistical analysis, and frequencies and percentages were used to represent categorical variables.

Ethics

The study was conducted according to the institutional ethics committee guidelines, and proper ethical clearance was obtained from the Ethical Committee of Government Medical College Srinagar (IRBGMC/Gynae).

III. RESULTS

The total number of live births during the study period was 36,273, of which 821 involved near-miss cases. There were also 34 maternal deaths in the hospital during the same period.

Our study revealed a maternal near-miss incidence ratio of 22.63 per 1000 live births, a maternal mortality index of 3.97%, and a near-miss to mortality ratio of 24.14:1.The median age of near-miss patients was 29 years (18-37), with the majority of patients aged between 20-35 years. Most of the patients (N=427;52%) were parity 1-2, and 319 (38.9%) were nullipara (Table 1).

Table 1. Patients' demographic variables.

Age (Years)	**N**	**%**
<20	58	7.06
20-35	623	75.88
>35	140	17.05
Parity		
0 (nullipara)	319	38.9
1-2	427	52
3-4	45	5.5
>5	30	3.7

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Gestational Age		
<13 Weeks	101	12.3
13-28 Weeks	66	8.04
>28 Weeks	531	64.68
Postpartum	123	14.98
Type of Admission		
Self	205	24.97
Referred	616	75.03
Of Referred		
Transport provided	493	80.03
Attended by staff	147	23.86
Severity		
Needed ICU admission	651	79.29
Needed HDW/ High-risk ward	170	20.71
Hospital Stay		
<10 Days	156	19
10-20 Days	608	74.06
>20 Days	57	6.94
ICU Stay (of total near-misses)		
>24 Hours	537	65.4
<24 Hours	114	13.9
Antenatal Care		
Received antenatal care	734	89.4
Did not receive antenatal care	87	10.59

The third trimester poses the highest risk for pregnant women to experience life-threatening situations, and most of our participants (N=531; 64.68%) were indeed beyond 28 weeks gestation when they suffered near-miss conditions. About 123 (14.98%) were post-partum at the time of near-miss. Haemorrhage (N=429; 52.25%), followed by hypertensive disorders of pregnancy (N=280; 34.10%), were the leading causes of MNM in our study (Figure 1).

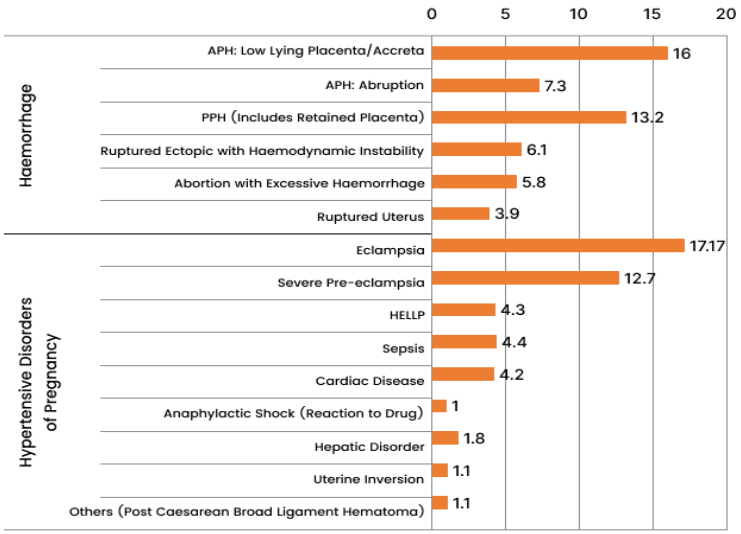

Figure 1. Distribution according to causes of near-miss.

The majority of the patients were near-miss upon arrival at the hospital (N=468;57%), while almost 337 (41.05%) were admitted with a disorder and became near-miss. Only 16 patients (1.95%) became near-miss having been admitted without any disorder. Most of the near-miss patients (N=651;79.29%)required admission to the hospital'sIntensive Care Unit (ICU), while other near-misses were managed in the High Dependency Ward (HDW) or High-Risk Ward. The mean duration of hospital stay for near-miss patients was 14 days, and the majority of those requiring ICU admission (N=537;65.4%) remained there for longer than 24 hours. Eighty-seven out of 821 near-miss patients did not seek antenatal care (ANC), the most common reason being the sudden onset of disease such as ectopic pregnancy, or abortion. Other reasons were obstacles to healthcare access due to living in difficult areas, and lack of awareness or of an attendant (Table 2). However, the majority of near-miss patients (N=700;85.26%) did receive ANC from a medical officer/ specialist.

Table 2. Reasons antenatal care was not sought

ReasonANC not sought	**N**	**% of those not receiving ANC**	**% of total near-misses**
Lack of awareness	11	12.64	1.33
Lack of attendant	3	3.45	0.36
Obstacles to access (living on hilly terrain, difficult areas)	10	11.49	1.21
Sudden onset of disease (ectopic, abortion)	63	72.41	7.67
Total patients who did not receive ANC	87	100	10.59

About 249 (30.33%) MNM patients were illiterate. Anaemia (N=460; 56.03%) was found to be the most common indirect factor associated with MNM, followed by previous Caesarean section (N=331; 40.32%). A total of 651 (79.29%) MNM patients were admitted to ICU, and 337 (41.04%) were intubated. Massive blood transfusion was required by 331 (40.31%) of the patients, while 303 (36.9%) needed inotropic support. A total of 253 patients (30.8%) required magnesium sulfate therapy for hypertension (Figure 2).

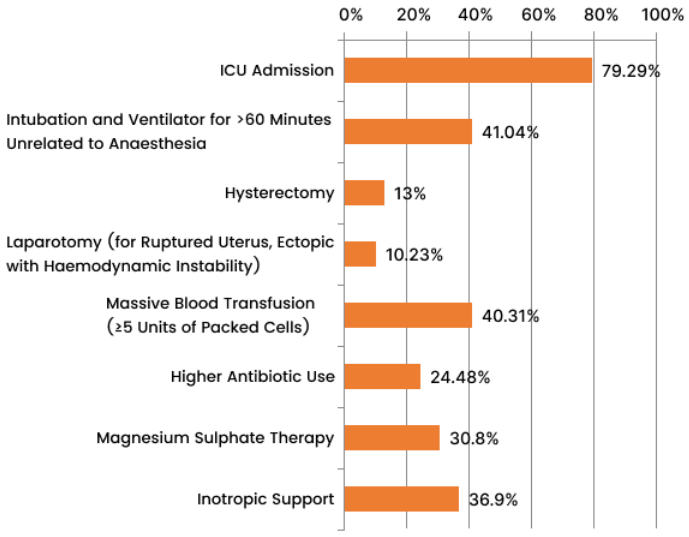

Figure 2. Distribution of patients according to management.

Our study found that haematology/coagulation was the most affected system in MNM patients (N=207; 25.21%). Most near-miss patients delivered by Caesarean section 497 (60.53%), and most had live births 590 (71,86%).

IV. DISCUSSION

This study presents an examination of cases of maternal near-miss based on prospective data from a tertiary care facility in Srinagar, Jammu and Kashmir. Near-miss cases were identified according to the MNM criteria provided by the WHO (2009). The MNM incidence ratio calculated in our study was 22.63 per 1000 live births; this aligns with findings from other studies in developing countries, which range from 15 to 40 per 1000 live births [8]. Kamal et al. reported a similar near-miss incidence ratio of 24 per 1000 live births in their study conducted at a tertiary care medical college in Jharkhand, India [8]. Similarly, Naderi et al. found a comparable incidence ratio of 25.2 per 1000 live births in their study in Iran [9].

The near-miss to mortality ratio in our study was 24.14:1, indicating that for every 24 to 25 occurrences of a life-threatening condition, one maternal death occurred. Studies conducted in Nepal and southern India reported ratios of 7.2:1 and 5.34:1 respectively, while a study in Maharashtra, India, reported a ratio of 14.2:1. Higher ratios are indicative of better care; thus, our ratio is superior to those reported in the aforementioned studies. Conversely, a Syrian study showed a better ratio than ours, of 60:1. However, these figures all pale in comparison to those reported in Western Europe, where ratios between 117–223:1 have been observed, possibly due to better available health care [10–14].

The maternal mortality index (MI) serves as a reliable indicator of healthcare quality within an institution [MI = MD / (MNM + MD)]. A higher index suggests more deaths among women with life-threatening conditions, indicating lower quality of care. Conversely, a lower index indicates fewer deaths among women with life-threatening conditions, suggesting better quality of care. In our study, the mortality index was calculated as 3.97%, indicating a better quality of care compared with studies conducted by Taher et al. in Egypt (MI = 8.6%) [15], El-Agwany et al. in Egypt (MI = 7.5%) [16], and Roopa et al. in Karnataka, India (MI = 14.9%) [17].

Our study identified obstetric haemorrhage as the leading cause of potentially life-threatening conditions and near-miss cases, accounting for 52.25% of cases, followed by hypertensive disorders of pregnancy at 34.10%. Similar trends have been observed in various other studies. Norhayati et al. reported comparable results in their study conducted in Malaysia [18], and a study by El-Agwany et al.in Egypt yielded similar findings [16]. Numerous studies in India have also demonstrated consistent results [19, 20].

In contrast, a study conducted in Syria identified hypertensive disorders of pregnancy as the primary cause of near-miss cases (52%), followed by obstetric haemorrhage. Another study in Ethiopia highlighted obstructed labour (45%) as the predominant cause, followed by haemorrhage [13, 21].

Indirect causes, often overlooked, also play a significant role in MNM cases. In our study, anaemia was identified as the most common indirect cause, affecting nearly 460 women (56.03%). Similar findings were reported by Tallapureddy et al. [11] and Sarma et al. [22] in their respective studies. Additionally, the majority of our patients (52%) had parity between 1 and 2, aligning with findings from a study conducted in Jharkhand, India [23].

In our study, a majority of near-miss patients were multiparous (61.2%), while 38.9% were nulliparous. Similar results were reported by Kurugodiyavar et al. in their study in Karnataka, India, and by Ranatunga et al. from Sri Lanka [24,25].

The third trimester of pregnancy poses the highest risk for potentially life-threatening situations in pregnant women. In our study, 64.68% of near misses occurred after 28 weeks of gestation, followed by the postpartum period at 14.98%. Similar findings were reported in a study by Gazala et al. [26].

A significant majority of MNM cases (60.53%) underwent delivery by Caesarean section, likely due to the severity of their obstetric conditions necessitating urgent intervention. This finding aligns with those of Umadevi et al. [27]. However, internationally, studies have noted an association between the increasing incidence of placenta previa and accreta with rising Caesarean delivery rates and previous Caesarean sections, potentially leading to complications such as near-miss incidents [28, 29]. Therefore, while Caesarean section may save patients in near-miss situations, it also presents risks such as accreta, which can lead to near-miss incidents in future pregnancies, making Caesarean section a double-edged sword.

In our study, the haematological system was the most commonly affected (25.21%), followed by the renal (17.78%) and respiratory (12.79%) systems. A study by Ismail et al.in Egypt [15] also showed haematology as the most commonly affected system in near-miss cases, consistent with our findings.

A substantial portion of near-miss patients (75.03%) were referred to our hospital from surrounding areas, similar to findings in other studies [26, 30]. Additionally, 65.7% of near-miss patients in our study were unbooked, a trend seen in studies conducted by Bindal et al. [20] and Kamal et al. [8]in India.

Upon arrival at our hospital, 57% of patients were near-miss cases while almost 337 (41.05%) were admitted with a disorder and became near-miss. Only 16 patients (1.95%) became near-miss having been admitted without any disorder. In line with our findings, Kamal et al. reported a similar percentage of patients being near-miss cases upon arrival at their hospital [8].

A multidisciplinary approach to ICU management, involving obstetricians, intensivists, and anaesthesiologists, is crucial for saving maternal lives. In our study, 79.29% of MNM patients required ICU care, a finding echoed in many other studies [8, 26].

Social factors, such as a lack of financial resources, lack of awareness, and, occasionally, lack of attendants, were found to influence near-miss incidents in our study. At the administrative level, issues such as inadequate transport, shortages of blood and blood products, and lack of surgeons and operating rooms at referral centres adversely affected near-miss occurrences. Addressing these challenges promptly is essential to the development of an effective maternal healthcare system.

The strengths of this study include the use of standardised WHO criteria andthe inclusion of diverse participants, while its limitations involve potential selection bias, incomplete data, variability in healthcare quality, and challenges associated with prospective analysis.

V. CONCLUSION

Effective management of MNM is a robust indicator of the quality of a state's healthcare system. Haemorrhage and hypertensive disorders were the leading causes of MNM events in our study population. Only prompt and appropriate intervention can avert the catastrophe of death in such patients; hence, an ICU with appropriate bed strength, as recommended by MCI, is essential in every obstetrics and gynaecology hospital. Moreover, the fact that the majority of near-miss casesin our study occurred before the patients' arrival at the hospital, underscores the importance of eliminating pre-hospital barriers. This can be achieved by improving the overall healthcare system, from the level of primary health centre, through sub-district hospitals, and up to district

hospitals. Healthcare personnel should be sensitised to obstetric emergencies and refer promptly when necessary.

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